

Description and Measurement of the Progress Eco-Sustainability

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Abstract

The research goal is the technical assessment of the lifecycle ecology quality, LEQ, of the tangibles' delivery, using TYPUS metrics and KILT description. Lifecycle starts when the supply chain idea is conceived and lasts until complete disposal is done, after manufacture, exploitation and recycle. The environment protection requires involvement of *sustainable companies*, which, since the beginning, operate by eco-design with the tied requirements' specifications. The LEQ has to follow: the many material flows, characterising the main lifecycle process; the nested side flows, during the design, manufacturing, assembly, service, maintenance, etc.; then: the disassembly, recycle, disposal, etc. phases, adding the tied testing and diagnostics stipulations. In the paper, the LEQ metrics is examined, on the measurement of the linked eco-protection functions.

Keywords

Eco-Sustainability; LEQ Metrics; Ecology Globalisation; Sustainable Corporation; Product Lifecycle Management

Introduction

The mankind progress is awkward issue, occurred on the earth, because of oddities, which bring in the twin <life> and <intelligence> singularities: the former leads to animated stuffs, with *agentive* wherewithal, based on information-driven self-replication; the latter starts relational abilities, up to *rationality*, into the human animal subset. The *agentive* processes support local reordering, using area matter/energy by self-contained programming. The *rational* procedures select improving aims, making the men effective towards the picked goals. We may assert that the twin singularities occurred on the earth; we do not have clear-cut elucidation of both; yet, the description of past facts seems authorising our trust in the mankind progress. The existing narratives entail the interplay of <matter/energy> *vs.* <information>, mainly, along two

paths: <monism>, the two merge; <dualism>, the two have independent sort. With *monism*, the quoted singularities coalesce; the *mind* is setup stage of the *brain*; the *information* cannot separate from the *matter/energy*: it is immanent. With *dualism*, the *transcendent* reading (opposed to the *immanent* one) distinguishes the <spirit> layer from the material one; yet: our experiments extend only within the latter; no empirical evidence of an upper one can build. The *monism*, however, denies our trust in the men's autonomy: the *information immanence* has the aftereffect to enjoy *a priori* design, i.e., it has *mandatory* force, with previously assigned allocation.

If we privilege the autonomous construal of a mankind progress, the outlined remarks are confusing. They, both, are *absolute* depictions, perhaps, leading to <the strong anthropic principle>, should we have the *faith* in the pre-established human mission, under *heavenly* mandate or *natural* determinism. Lacking this faith, the engineer's approach prefers *relative* portrayals, preserving the autonomy of the <life> and <intelligence> singularities and ascertaining the men's civilisation as the purposive brainpower's result, which builds on *a posteriori* checked figures. The *relative* pictures explore the *relational* virtues of <intelligence>, i.e., the fact that men are the only animals developing the interpersonal artefacts of <culture> and <ethics>. The oddness of foundation *intangibles* is manifest, when we look over exacting human *inventions*: <grammar/syntax> for the idioms; <metrics/standards> for the *trade*.

The *relational* <intelligence> is interpersonal wherewithal, supporting (Michellini, 2008; Michellini, 2009; Michellini, 2010; Michellini and Razzoli, 2012):

- operation dualism, extricating mind worlds, with value added provision;

- contingency logics, carrying out choices on a *a posteriori* assessment tests;
- decision keeping abilities, endowed of autonomously managed free will;
- processing capabilities, implementing the designed and planned activities.

The *relative* pictures presume the *firm* belief that mankind enjoys «the *weak* anthropic principle», (Michelini and Razzoli, 2013), by which the men's mission is just a *a posteriori* contingent issue. The approach gets rid of *absolute* truths, by replacing the resort to perfect natural laws via the *falsification principle*, or the via the *creative* ceaselessly new knowledge. To close the clues, the reliance on anthropic options can resort to different postulations, for example, (Belotti et al., 2002; Michelini, 2012):

- the heavenly mandate, giving especial *entrustment* to the men knack;
- the automatic (or *deterministic*) deployment of the human proficiency;
- the unforeseen happenstance, allotting *factual worth* to coincidences;
- the last outlined *mind functions*, backed by decision-keeping freedom.

The first two are steered by upper either inner information: we are totally unqualified. The third cannot be trusted, as a causal link is not perceived. Only the fourth one allows figuring out the mankind progress as a *sustainable* issue, once a *a posteriori* outcomes are found to confirm our expectations.

Sustainable Growth: Bottom-Up View

On our earth, the civilisation distinguishes because of «life-quality» figures. The value added is obtained by matter/energy provisions and transformation and by interpersonal organisation and ruling. The two paths are synergic: the latter characterises by series of «social breakthroughs», adapting the political setups and the civic outfits; the former conventionally refers to «technology revolutions», say, up today, the *agrarian* and *industrial* ones. The *breakthroughs* are centred on intangibles, with fallouts on the enabled collective orders. The *revolutions* entail the processing of tangibles: they, thus, deals with the surrounds and related entropy decay. The *absolute* logics trust causal links, rooted in upper/inner information; so, the faith in the *strong* anthropic principle might support growth continuance. The *contingency* logic is not less critical, since the dependence of the progress on natural

resource provision and on biosphere defence is factual request, directly involving to balance the tangible quantities, under the human direct appreciation. The diversity of the two approaches relies in the stepwise enabling of the latter, due to the weirdness of its relational sort; as previously pointed out, now, the *autonomous* decision-making gift goes together with, (Michelini and Razzoli, 2013):

- suited sets of «shared aptitudes», conventionally described as *intelligence*;
- actual «decision abilities», entrusted through *freewill* choice wherewithal.

The skills sum up, saying that men are accountable for their fortune or misfortune. The progress is wholly ascribable to how they interact between them and with the surrounds.

The Fundamental Constituents

To be measured, the life-quality improvement requires a measurement scale considering order, increments or ratios with increasing information content, apposite measurement procedures and accepted standards. Men are the only animals inventing the «trade» supported by «money». The system is enacted by issuers, allotting officialdom backing, namely: the *invention* entails political formats. The human wealth that follows is conventional effect, which involves *potentially* tradable items: an *explicit* «worth» or «price» exists only for those put on the market. The Fig. 1 lists the reference assets. The *contingency* logic justifies that, up today, the «market law» could suffice expressing values, simply, on a *a posteriori* assessments.

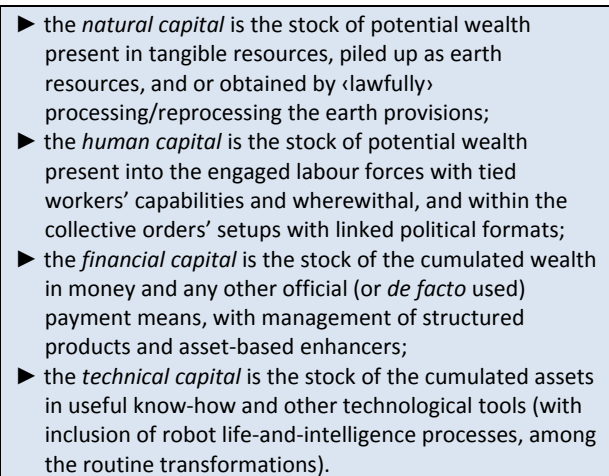
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- the *natural capital* is the stock of potential wealth present in tangible resources, piled up as earth resources, and or obtained by «lawfully» processing/reprocessing the earth provisions;
 - the *human capital* is the stock of potential wealth present into the engaged labour forces with tied workers' capabilities and wherewithal, and within the collective orders' setups with linked political formats;
 - the *financial capital* is the stock of the cumulated wealth in money and any other official (or *de facto* used) payment means, with management of structured products and asset-based enhancers;
 - the *technical capital* is the stock of the cumulated assets in useful know-how and other technological tools (with inclusion of robot life-and-intelligence processes, among the routine transformations).

FIG. 1 THE REFERENCE ITEMS, SUPPLYING VALUE ADDED

The four capital assets set apart, because: the first two engage tangibles; the other two affect mind results, with *endorsed* or under *registered* assessments. The

ecology, recently, obliged to update our views on the natural resource provision: on the earth, their availability is finite; their transformation ends in wastes and pollutants. The <market law> loses its factual plainness, being required to add suited *a priori* biases.

The Bottom-Up Description

With the *industrial* revolution, the value added improvements obtain essential contribution by manufacture processes, transforming *raw materials* into *marketable products*, using *artificial energy*. The growth pace is man-controlled, being linked to manufactured quantities Q , depending on the chosen and enabled plans. In the descriptions, the faulty two-polar, I -investment, L -labour, mode, needs to switch into the four-polar, K -know-how, I -investment, L -labour, T -tangibles, mode, Fig. 2, resorting to instant and incremental figures.

$Q^* = \alpha_0 IL;$	$Q^* = \gamma_0 KILT$
$\Delta Q^* = \beta_0 IL - \beta_I I - \beta_L L;$	$\Delta Q^* = \delta_0 KILT - \delta_K K - \delta_I I - \delta_L L - \delta_T T$

FIG. 2 THE ASSET-DRIVEN MODES, DESCRIBING THE PRODUCTION FLOW

The I and L sameness in the shop-floor throughput planning is expanded to include the K and T assets, and to build the $KILT$ model. The instant output Q of the contributed assets is equally affected by each of the normal inputs (the norms depend on the business project, and are included in each asset, when converted in money). The increment model ΔQ says that any imbalance penalises the choices by explicit weights. The *tetra-linear* (say, *bi-linear*) dependence is approximation, which assumes the non-correlation of the assets. The increment model shows that the nominal output decreases in proportion to each imbalance. The $KILT$ model tells that the exclusion of one input makes the output faulty: the flow cannot balance without, e.g., the tangibles T . The extra charge of an input affects the output: it is offset by the lower cost of another one (e.g., we can look at the partial balance of T by K), (Crenna et al., 2001).

The *relative* pictures (*contingency* logic) profit by metrics founded on the comparative ratios of the <market law>. The evaluation standards are the unlike national moneys. The equalisation methods resort to the bias of the split-sovereignty nation-states. The bottom-up measurement schemes avail of mixed-mode concern. The $KILT$ model is conceived as technical support, only requiring that the K , I , L and T

equivalence on the planned output Q has to be weighed up *vs.* the depletion/contamination falloffs and reclamation/restoring burden. The demands have technology import, and they very little affect the political cohesion sceneries, if worldwide eco-uniformity is well-kept. They help supplying technical arrangements. The figured out hints outline operation constraints, once the eco-sustainability needs to be tackled, after coherent changeovers of the extant political <collective orders>, (Michelini and Razzoli, 2004a; Michelini and Razzoli, 2004b). This focused description/measurement procedure allows specifying the technical assessment of the lifecycle ecology quality, LEQ, of the supply chains, which is main goal of the present study, to discern the value added built-up on its actual sustainability figures.

Salvage Prospects: Top-Down Conflicts

The descriptions with mixed-mode concern have dubious coherence, merging the top-down and bottom-up methods in the measurement procedures. The *absolute* logics have gauged weight, trusting in upper/inner information, to justify collective orders, termed by <heavenly grace> or <race even purity>. The *contingency* logic is current reference, to support <constitutional> sovereignty. The blending of the two yields conflicts, Fig. 3, especially, when contrasting globalisation trends occur, (Crenna et al., 1998a; Michelini and Razzoli, 2010).

- *natural capital*: ecology absolute assessment vs. market provisioning agendas;
- *human capital*: inner authenticity vs. plebiscitary (demagogical) dependability;
- *financial capital*: official money issue vs. financial treatments and speculation;
- *technical capital*: patents and concessions vs. creative knowledge deployments.

FIG. 3 MISMATCHES IN TOP DOWN/BOTTOM UP SCHEDULES

The ecology globalisation tells that our earth is a <global village>: there is no chance to castle in safe resorts: trash and contamination are common falloff, without frontiers, even if we fragment our world in supposed autonomous countries. The *relative* pictures do not apply, because the earth's salvage has to be shared. So, if the extant political and economic structures are intrinsic setups, very little can be done. The introductory remarks suggest that the progress is *contingency* ending of intelligence processes; the collective orders are, similarly, *contingent* institutes, to be modified/replaced, whether needed or helpful.

The Ultimate Eco-Defence Goal

The eco-protection is mandatory requirement at the earth's extension. Of course, the growth shall not last forever, but we need to plan suited recycle/recovery plans, to remove litter and to renovate supplies up to suited targets, agreed at worldwide rank. The switch from tangibles to intangibles helps cutting brood. The 'collective order' value added links with *political* (nation-state), *business* (corporation) and *alliance* (amity) options; the related amounts are mainly immaterial; governments and enterprises assure compulsory force to the bureaucracy or agreement eco-defence. At this point, the eco-safeguard metrics, Fig. 4, equivalently, might follow officialdom issue, or have worldwide contractual cogency. The first way shall be completed by interstate protocols; the second one has to refer to distributed 'big society' bylaws and related 'settlement councils', (Acaccia et al., 2007; Micheline and Razzoli, 2010).

- *tangibles' yield per unit service*, TYPUS: the appraisal embeds the full tangible supply chain, from procurement to recovery, so that each delivered product-service entails associated figures, assembling resource depletion and all the falloffs requiring remediation.

FIG. 4 THE ECO-SAFEGUARD METRICS

The interstate treaties are established habit, to settle the doings having shared concern. The TYPUS metrics, in particular, classifies in the ecology metrology domains, which enjoy sure priorities. Yet, the application of the standards is object of *political* interpretations, and, certainly, each single nation-state will not omit their *changes*, to show attention towards their citizens, under sovereign privileges. The second way, presently, is out of acknowledged practices: it replaces the *governmental* ruling, by the *economic* controlling; it needs to invent the adequate *business's* organisation, assuring mandatory citizens' accomplishment, out of the older sovereignty schemata. A few cues follow.

The 'Sustainable Corporation' Choice

The *economic* control, in the history, develops when the governance officialdom becomes lousy. In Europe, at the end of the Middle Age, lacking Empire/Church authority, the 'city-state' epoch started, utilising interstate 'venture companies' for the growth promotion. Currently, we experiment the *financial globalisation* of the 'hypermarket', with turnover of some multi-nation corporations larger than the one of marginal countries. Now, the situation also avails of

information globalisation, supporting *extended/virtual enterprises*, which combine tasks and services, to enhance the supply chain proficiency by *product lifecycle management*, PLM, *service engineering*, SE, and/or *reverse logistics*, RL, getting *product-process-environment-enterprise*, 2P2E, integration, whether required or helpful, (Micheline and Razzoli, 2004b; Micheline, 2012).

The 'sustainable corporation' option belongs to the sketched course. From merely technical standpoints, the coherent eco-design evolves using 'lifecycle inventory' with suited 'product lifecycle assessment', PLA. The procedure entails combined tools, currently described by changeable knowledge frames, progressively modified, when the eco-consciousness increases, still, basically resorting to standardised computer aids, depending on specialised tasks, Fig. 5.

- competing product-service choice, by *streamlined lifecycle assessment*, SLA, tools;
- product-service delivery, trimmed by *computer aided lifecycle inventory*, CALI, aids;
- lifelong monitoring, diagnoses and evaluations, done by PLM, SE and RL databases;
- setting of *accredited/notified certification*, ANC, bodies, for supply chain lawfulness.

FIG. 5 THE SUSTAINABLE CORPORATION TECHNICAL FRAMES

The technical procedure starts by the 'streamlined lifecycle assessment', SLA, using an appraisal, capable of interfacing the 'product lifecycle assessment', PLA, requirements with the whole PLM, SE and RL databases. It ends with the conformance certification, done by third-party, which needs to be *accredited* (by recognised technical agencies) and *notified* (to the involved governmental authorities). The course is reasonable. The enterprises qualify their know-how: from the former CAD and CAM *design* setups, to the upgraded SLA-CALI-PLM/SE/RL-*operation* competences.

Several tricky questions, for sure, remain unsolved. We can point out that, among possible planning, the following ones deserve attention:

- the allocation of the 'eco-duties' in charge to accredited *sustainable* corporations;
- the organisation of the 'eco-control' by front-end *big-society* distributed sceneries.

The 'civic' control exerted by 'big society' settings privileges the structured collective orders, interfaced to eco-accredited 'trade companies', making redundant a 'nation-state' role in the management of the legal arrangements. It is radical changeover with

respect to the *ethical state* notions. The switch assumes that a *rational* citizen does not need cogent authority to behave lawfully. The notion can have sound foundations; the whole humanity shares the same *inborn* values, and the «categorical imperatives», derived by the man reasoning and affecting the interactive conduct, are shared targets. In such views, the *innate* «relational» worth (stated by *fusion construal*), becomes technical matter, done by skilled «sustainable corporations», «third sector» entrusted into the involved «big societies» and «trade companies» jurisdiction.

Conclusions

The globalisation scenarios give advices (and warnings) for these *constituent* connections, turning *political*, to *economic* «relational» value added paths. Indeed:

- the ecology globalisation states the essential targets and mandatory goals;
- the economy globalisation runs the operation skills, frames and controls;
- the communication globalisation helps through the transparent monitoring.

The *KILT* model is the central description, to explain the changeover; the TYPUS metrics is the reference, to build the above outlined switch of the «collective order» efficient organisation of the men's progress. When looking at the capital asset mismatches, Fig. 3, the remarks have, mainly, involved «collective order» setups, with linked political formats. The (European) tradition stresses the lead of «nation-state», over «city-state» efficiency. In the XX century, after the two worldwide wars, the claim requires being modified to look at the continental size. With the new millennium, the current globalisation makes even this choice disputable. In like time, also the dyscrasia in the *financial* (e.g., virtual wealth bubbles) and in the *technical* (e.g., patent's regimes) assets show that the split-sovereignty has more shadows than virtues.

The present discussion, however, limits to the acknowledgement of apt description/measurement ways, if the ecology treats are surfacing. The precision acknowledgment of the phenomena is totally outside the «market law», more related to scientific *absolute* depictions, than to engineering *relative* pictures. The fact, nonetheless, shall be solved by *contingency* logic, for the reasons initially outlined. The sketched out mode follows the three steps of defining comparative

ratios, apposite methods and accepted standards, (Crenna et al., 1998b), in view of the exactness of the ecology frame, the strictness of the (*KILT*) model, and the accuracy of the (TYPUS) metrics. The choice is not obvious, as, until today, the actually engaged capital assets entail diverse reading, not at all equivalent. The sketched measurement mode has further fallouts.

The detailed account of the *four* capital assets provides the data for the *a posteriori* open regulation of the depletion and the pollution trends, suffered by biosphere. The reclamation/restoring practice is compulsory obligation of the «organised society» eco-consistency. The communication globalisation allows focusing on the robot age reliefs (aiming at the fractional offsetting of *T* by *K*), empowering the technology, economy, civic and ecology stages of the productive processes, described by the *KILT* model. The prospect is here mentioned, as further cue, to foster the factual effectiveness of the discussed measurement scheme.

The present study proposes the decisive technical assessment of the lifecycle ecology quality, LEQ, of all the value aided deliveries, using *KILT* description and TYPUS metrics. On factual engineering viewpoints, the environment protection requires involvement of *sustainable corporations*, according to the above detailed specifications. Thereafter, the LEQ has to follow: the many material flows, characterising the main lifecycle process; the nested side flows, during design, manufacturing, assembly, service, maintenance, etc.; then: the disassembly, recycle, disposal, etc. phases, with the testing and diagnostics stipulations, emerging from the here summarised LEQ description/measurement ways. The study's hints suggest that the ecology quality needs to be bigger than one (including the intangible stimuli): a different figure means that spoil and decay are dominant: the growth is not sustainable.

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